

## Surveillance for Zoonotic Diseases

November 4, 2013

Dr. Marilyn Goss Haskell

### **SLIDE 1** Title

### **SLIDE 2**

Hello, my name is Marilyn Goss Haskell and I am one of the state's public health veterinarians with the North Carolina Division of Public Health, Communicable Disease Branch. This presentation is about Surveillance for Zoonotic Diseases.

### **SLIDE 3**

The learning objectives for this presentation are

- Describe what makes a communicable disease zoonotic.
- Identify the causative organism for tularemia, brucellosis, and Q Fever
- Describe the major routes of transmission for tularemia, brucellosis, and Q Fever
- Locate guidance for Case Definition and Disease Investigation Steps for Reportable Diseases in North Carolina

By the end of this talk you should be familiar with the organisms that cause these zoonotic diseases and how the diseases are transmitted to people, some through a variety of different routes, and some not so obvious. During an investigation, determining the source of exposure will require some detective work on your part. Most people think of Rabies when they think of a zoonotic disease but there are three other important zoonotic diseases of concern in North Carolina: tularemia or "Rabbit Fever", brucellosis or "undulant fever", and Q-Fever or "Query Fever". Notice they all have one thing in common, the word "fever." Most people are not familiar with how zoonotic diseases are transmitted and what makes people at risk. Often physicians don't suspect these diseases because they are rare. Questions about animal exposure history may not be elicited or the patient may not know to tell the physician about their occupation, recreational activities, animal exposures and travel.

### **SLIDE 4**

Some of the resources that you will use to investigate and become familiar with these and other reportable zoonotic diseases are on this slide. A key resource for you is the North Carolina Communicable Disease Manual. Be able to locate the Case Definition and the Disease Investigation Steps for each disease.

### **SLIDE 5**

What is a zoonosis? *The Dictionary of Epidemiology*, defines a zoonotic disease as an infection or infectious disease transmissible under natural conditions from vertebrate animals to humans. According to the CDC about 60% of all human pathogens are zoonotic and about 75%

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of recently emerging infectious diseases affecting humans are diseases of animal origin. Zoonotic diseases can be caused by bacteria, viruses, parasites, and fungi that are carried by animals and insects. Some examples that you may know about are listed on this slide. We will talk about three of these today: tularemia, brucellosis and Q fever.

#### **SLIDE 6**

Diseases and conditions that have been declared to be dangerous to public health under the NC Administrative Code in Title 10A are reportable to the local health director and the Department per NC General Statute. All reportable diseases are listed in the code including the time frame required for reporting a particular disease or condition once the disease is reasonably suspected to exist:

- Anthrax and Tularemia – shall be reported immediately
- Brucellosis - within 7 days, and
- Q Fever - within 7 days

Physicians and laboratories are required to report these diseases. Physicians are required to report as soon as they suspect on the reportable diseases. Many of the NC reportable zoonotic diseases are also potential bioterrorism agents. Anthrax and Tularemia, are considered Category A or high-priority agents that pose a serious risk to national security because they are transmitted easily from person to person resulting in high mortality rates, with the potential to have a significant impact on the public causing mass panic and social disruption. Brucellosis and Q fever are Category B agents. They are moderately easy to disseminate resulting in moderate morbidity rates and low mortality rates

#### **SLIDE 7**

An investigation of a zoonotic disease will usually begin with a laboratory result that is either presumptive or confirmed entered into NC EDSS. When you conduct a zoonotic disease investigation you will follow these steps:

- Report the case to the CDB Subject Matter Expert through NC EDSS or a phone call.
- Review Case Definition and read about the disease (see resources).
- Use the Disease Investigation Steps and Reporting Form questions in the CD Manual.
- Complete the clinical and risk history packages in NC EDSS.
- Determine the source of transmission through review of the hospital and clinical records, interview the patient and/or family; follow up on all other contacts with a similar illness and/or exposure, and investigate potential laboratory exposures to culture isolates.

#### **SLIDE 8**

Tularemia is caused by a very infectious bacterium that occurs naturally throughout the United States in animals (especially cottontail rabbits, hares and rodents). Animals that are infected will often not appear ill. Tularemia can be a very serious illness, the organism can enter the human body through the skin, eyes, mouth, throat, or lungs. Usual sources of infection include contact with infected animals or carcasses; in particular, in North Carolina, cases have been associated

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with rabbit hunters and bites from feral cats. Skinning, eviscerating, and performing necropsies on infected rabbits without gloves are high risk activities. Consuming undercooked meat or cross contamination of surfaces with meat from an infected rabbit is a risk factor for transmission. One area of focus for education is rabbit hunters in your community. Ticks and deer flies are also capable of transmitting tularemia. Tularemia can be transmitted by inhalation of contaminated dusts or aerosols when mowing property where the remains of dead rabbit carcasses may be present in the soil. Remember that it takes very few organisms to transmit this disease and that if there are multiple cases within a short time frame in a particular geographic area, a bioterrorist event should be considered. Transmission of tularemia from person to person has not been reported.

#### **SLIDE 9**

The incubation period for Tularemia is from 1 to 14 days. Part of the risk history is to determine the patient's occupation, outdoor recreational activities and any animal contacts (live or dead) within 14 days prior to clinical onset. Hunters, veterinarians, wildlife workers, campers, hikers, people that have handled or been bitten by a cat (usually an outdoor or feral cat) as well as people that have skinned, eviscerated or prepared rabbits and other wildlife for consumption are at increased risk for infection.

#### **SLIDE 10**

This graph displays the number of Tularemia cases reported in NC since 2008 by date of symptom onset. Among nine human cases, 7 were confirmed and 2 probable; 90% were male, with an age-range from 9 years to 65 years old; median age of 52. The most common activity consistently reported by patients was hunting rabbits in 7 of 9, or 80% of cases, including skinning, dressing and consumption of rabbit meat. Two cases had a history of being bitten by feral cats. Counties represented include: Martin, Wake, New Hanover, Rowan, Halifax, Pitt, Orange, Washington, and Tyrrell. The following story will help you understand why rabbit hunters should be educated about how to prevent this disease prior to the start of rabbit hunting season. In late December 2012 two rabbit hunters in eastern NC hunted, skinned and dressed four rabbits without gloves. One of the hunters cut himself with a knife while skinning the rabbit. They then cooked and prepared rabbit salad with the rabbit meat and consumed the rabbit salad. Four days later they were both hospitalized in the ICU with a combination of clinical forms: typhoidal and pneumonic. Both patients had to be intubated due to respiratory distress, were severely ill and had a long convalescence. The hunters probably ate undercooked meat or contaminated food, the bacteria got into their bloodstream and then into their lungs.

#### **SLIDE 11**

The Case Definition for Tularemia requires that the patient meet the clinical description criteria for one or more forms of tularemia that may develop depending on how the organism entered the patient's body. Let's talk a bit about each form:

**Ulceroglandular:** The hallmark of this form is a cutaneous ulcer with regional lymphadenopathy (usually in the armpit or groin). This is the most common form of tularemia and usually occurs following handling an infected animal without personal protection (there may also be history of a cut while skinning or preparing the carcass) or a bite from infected animal, tick or deer fly.

The **Glandular** form manifests as regional lymphadenopathy with no ulcer. Also generally acquired through the bite of an infected tick or deer fly or from handling sick or dead animals.

The **Oculoglandular** form manifests as conjunctivitis with swelling of lymph nodes in front of the ear. This form occurs when the bacteria enter through the eye. This can occur when a person is butchering an infected animal and touches his or her eyes.

**Oropharyngeal** The patient has stomatitis or pharyngitis, a sore throat, mouth ulcers, or tonsillitis and cervical lymphadenopathy. This form results from eating or drinking contaminated food or water.

The **Intestinal** form is characterized by intestinal pain, vomiting, and diarrhea.

The **Pneumonic form** is the most serious form of tularemia and is primarily a pleuropulmonary disease with cough, chest pain, and difficulty breathing. This form results from breathing dusts or aerosols containing the organism. It can also occur when other forms of tularemia (e.g. ulceroglandular) are left untreated and the bacteria spread through the bloodstream to the lungs.

The **Typhoidal** form begins as a febrile illness without early localizing signs and symptoms. This form represents a septicemic state, when the bacteria has gotten into the bloodstream, and is often associated with the other forms. Sometimes more than one form will be present in a patient. Illness ranges from mild to life-threatening. Among the nine NC cases, the most common form detected in North Carolina has been ulceroglandular.

#### **SLIDE 12**

To meet the Case Definition for a confirmed case of tularemia the patient must have a clinically compatible case with one or more of the clinical forms and confirmatory laboratory results as indicated on this slide.

#### **SLIDE 13**

To meet the Case Definition for a Probable case of Tularemia the patient must be a clinically compatible case with one or more of the clinical forms of tularemia with laboratory results indicative of presumptive infection as indicated on this slide.

#### **SLIDE 14**

Tularemia can be difficult to diagnose. It is a rare disease, and the symptoms can be mistaken for other more common illnesses. During the investigation it is important to identify potential exposures sources for example, occupational and recreational risks. Several antibiotics may be used to treat tularemia. Treatment usually lasts 10 to 21 days depending on the stage of illness and the medication used. Although Tularemia can be life-threatening and symptoms may last for several weeks, most infections can be treated successfully with antibiotics and most patients completely recover.

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## **SLIDE 15**

Investigating potential laboratory exposures is another important aspect of a tularemia investigation. *Francisella tularensis* is highly infectious when grown in culture, and laboratory-acquired infections have been documented. The Communicable Disease Branch should be notified of all laboratory facilities that may have performed blood or specimen cultures while the patient was ill. CDB will help conduct the investigation of laboratory exposures.

## **SLIDE 16**

As public health practitioners, primary prevention of disease is our mission and role. Prevention messages for tularemia should be directed to those persons at risk in your community, including: Hunters and trappers; hikers, campers, and those that work and recreate outdoors; and persons involved in mowing and landscaping. See the tularemia resource slide at the end of the presentation for a link to the CDC website on Tularemia Prevention for each risk category.

## **SLIDE 17**

Let's switch over to another serious zoonotic disease, Brucellosis also referred to as "undulant fever" in humans. Brucellosis is caused by a bacterium and is an important cause of reproductive problems and abortion in animals worldwide. NC was declared "brucellosis-free" for domestic cattle in 1984 and for commercial swine in 1990. There are three species of bacteria, with different animal reservoirs, that commonly cause brucellosis in people – *Brucella suis* of swine, *Brucella abortus* of ruminants, and *Brucella mellitensis* of sheep and goats. *Brucella canis* of dogs may also infect humans but these events are rare.

## **SLIDE 18**

People generally get the disease when in close contact with infected animals or their products. The most common way to be infected with brucellosis is by eating or drinking unpasteurized or raw dairy products (milk and/or cheese) contaminated with the bacteria. Eating undercooked meat from infected animals is also a risk in certain countries and for hunters in the US. Breathing in the bacteria that causes brucellosis may also lead to infection. This generally occurs when there are laboratory exposures. Aerosols of the organism are also responsible for infections in slaughterhouse and meat-packing employees and could occur during a necropsy or while butchering and eviscerating infected animals. Bacteria can enter wounds in the skin and or mucous membranes through contact with infected animals. Feral swine hunters in NC have been infected this way. Person-to-person spread of brucellosis is extremely rare. Infected mothers who are breast-feeding may transmit the infection to their infants. Sexual transmission has been rarely reported. While uncommon, transmission may also occur via tissue transplantation or blood transfusions.

## **SLIDE 19**

**The occupational and recreational risk history is an important part of any investigation.**

Brucellosis poses a problem for workers who have close contact with animals or animal excretions including: slaughterhouse workers, meat-packing plant employees, veterinarians, farmers and ranchers. In 1991 and 1992, 30 of 156 workers in the kill division of a Sampson county pork processing plant met an outbreak definition for brucellosis. Sixteen of the 30 affected workers had not previously been diagnosed with brucellosis, four of these workers on the kill floor were exposed to infected swine through breaks in their skin, inhalation and/or conjunctival contact. People who hunt or work with feral swine in NC may also be at risk when they are in contact with infected animals. Hunting bison, elk, caribou, and moose elsewhere in the US may pose a risk of brucellosis. Laboratory workers that manipulate culture isolates outside the hood, are at risk.

#### **SLIDE 20**

For the brucellosis exposure risk history always ask about travel outside of the US during the 6 months prior to symptom onset (the longest incubation period). Was the patient deployed in the military (including family members), a tourist, on a convention or a missionary trip? What country did they travel to and did they consumed raw or unpasteurized milk or cheese or undercooked meat from sheep, cattle or goats. Although brucellosis can be found worldwide, it is more common in countries that do not have effective public health and domestic animal health programs. Areas considered high risk are listed on this slide.

#### **SLIDE 21**

This graph displays the number of human brucellosis cases reported in North Carolina from 2008 through September 2013 based on symptom onset. Among 8 cases reported, 6 were confirmed and 2 were probable; 6 of 8 cases or 75% were male; and the ages of the cases ranged from 36 to 63 years old with a median and average age of 48. The most common risk activity reported by 5 of 8 cases or 62.5 % was travel to a country endemic with brucellosis (Mexico, Italy, Iraq or Kuwait) with reported consumption or potential consumption of unpasteurized dairy products and/or contaminated meat. Two cases were feral swine hunters that slaughtered hogs (one in NC and one in FL), and one person was a laboratory worker exposed to a *brucella suis* isolate cultured from a specimen taken from an infected feral swine hunter from Florida.

#### **Slide 22**

To meet Case Definition for Brucellosis (2010) either confirmed or probable, a patient's clinical signs must meet the following criteria: An illness characterized by acute or insidious onset of fever, AND one or more of the following clinical signs listed on this slide.

#### **Slide 23**

To confirm a case of Brucellosis the patient must meet the Clinical criteria AND also meet the Definitive Lab Criteria Listed on this slide. The CDC runs the gold standard Brucella Micro-agglutination Test or BMAT. Samples are submitted through the NC SLPH to the CDC. The

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Standard Tube Agglutination Test is run by Quest Diagnostics and is submitted by the provider. Either of these agglutination test results can be used to meet case definition.

#### **Slide 24**

To meet the Probable case definition of Brucellosis the patient must have met the Clinical criteria AND the Presumptive Lab Criteria listed here. Note, and this is important, a positive IgM ELISA cannot be used to meet case definition. The CDC has published an MMWR, located in your reference list at the end, which addresses misinterpretation of this test. If you have questions, call the brucellosis SME at the CDB.

#### **SLIDE 25**

As with tularemia, investigating and managing potential laboratory exposures to *brucella spp.* isolates is part of the investigation of a suspect, probable or confirmed case. Brucellosis is the most commonly reported laboratory-associated bacterial infection. The Communicable Disease Branch should be notified of all laboratory facilities that may have performed blood or specimen cultures during the incubation period. CDB will help conduct the investigation and risk assessments of laboratory exposures in concert with the SLPH and the occupational health or employee health of the laboratories involved.

#### **SLIDE 26**

Before treatment begins, a diagnosis of brucellosis infection must be made by a doctor.

Generally, the antibiotics doxycycline and rifampin are recommended in combination for a minimum of 6-8 weeks. Find out if the suspected case is pregnant; allergic to doxycycline or rifampin; or is immunocompromised. Depending on the timing of treatment and severity of illness, recovery may take a few weeks to several months. Death from brucellosis is rare, occurring in no more than 2% of all cases.

#### **SLIDE 27**

In summary, brucellosis is a serious, potentially chronic debilitating disease that may not be suspected by many physicians. Primary prevention for brucellosis is critical and includes hunter education, and education of travelers and military personnel about risks. Once a patient is suspect, probable or confirmed for brucellosis a thorough investigation of the source of infection should be done as well as a contact investigation and laboratory investigation of any other exposures.

#### **SLIDE 28**

Q fever, also known as “query fever” or “abattoir fever,” is a worldwide zoonosis with acute and chronic stages caused by the bacteria *Coxiella burnetii*. The disease is underreported and underdiagnosed because the symptoms of the acute form are non-specific creating a diagnostic challenge for many healthcare providers. Cattle, sheep, and goats are the primary reservoirs and often will show no signs of disease. Infected animals excrete organisms in the milk, urine, feces and in birthing fluids and products in very high numbers. Bacteria is extremely hardy and resistant to heat, drying and many common disinfectants. The organism is able to survive for

months to years in the environment and becomes a potential source of infection through aerosolization.

#### **SLIDE 29**

In 2013 the CDC and Q Fever Working Group published this MMWR and recommendation, *Diagnosis and Management of Q Fever in the United States, 2013*, that is accessible on line at this link. This MMWR is a detailed and comprehensive resource for physicians, occupational health and public health that provides information about recognition of clinical features of both the acute and chronic forms, taking a risk history, the epidemiology, interpreting diagnostic testing, monitoring high risk patients, treatment, public health reporting, and much more.

#### **SLIDE 30**

Infection in humans usually occurs by inhalation of bacteria from air that is contaminated by excreta of infected animals, for example, barnyard dust that has been contaminated with dried placental material and birth fluids from infected cattle, sheep or goats. Direct contact with animals is not required for infection. Transmission can occur, although rare, through tick bites, ingestion of unpasteurized milk or dairy products, blood transfusion, bone marrow transplantation, human to human transmission, and nosocomial transmission through autopsies and obstetrical procedures. Humans are often very susceptible to the disease, and very few organisms may be required to cause infection.

#### **SLIDE 31**

The risk history for Q fever should include occupations that have contact with animals or animal products, such as slaughterhouse workers, veterinarians, ranchers and farmers. However, infection is not always limited to these groups. Living in a rural area or living on or within 10 miles of a livestock farm with cattle, sheep or goats poses a risk. Urban outbreaks have occurred with no known direct contact or proximity to livestock. The largest known outbreak of Q Fever in humans occurred in the Netherlands from 2007-2010, involving 4000 human cases and was presumed to be linked to dairy goat farms located near densely populated areas. Human exposure occurred through wind drift of contaminated dust and some cases were documented within 10 miles of the farms. Travel to areas of higher risk for Q fever in the US include agricultural areas. The Middle East is considered highly endemic. Several NC cases were EPI linked to travel in the Middle East, where, according to the patients, goats and sheep roam freely through the streets of the cities.

#### **SLIDE 32**

Interpretation of serologic results for possible Q fever must include the differential reactivity of *Coxiella* antigens. The organism, *C. burnetii*, exists in two antigenic phases, phase I and phase II. Phase I is the virulent, highly infectious form that undergoes transition to phase II, the avirulent form, during serial laboratory passages in embryonated eggs or cell cultures. In acute infection,



the Phase II antibody response to *C. burnetii* appears first and is higher than the Phase I antibody response. With Chronic infection, the Phase I antibody response is higher than Phase II.

### **Slide 33**

Q fever can cause both acute and chronic illness in humans. The acute symptoms usually develop within 2-3 weeks of exposure, although as many as half of humans infected with *C. burnetii* do not show symptoms. Symptoms of acute Q fever are non-specific and include high fevers (up to 104-105°F), severe headaches, w other Flu-like symptoms.

Although most persons with acute Q fever infection recover, others may experience serious illness with complications that may include pneumonia, granulomatous hepatitis (inflammation of the liver), myocarditis (inflammation of the heart tissue) and central nervous system complications. Pregnant women who are infected may be at risk for pre-term delivery or miscarriage. The estimated case fatality is low, about < 2% of hospitalized patients. A post-Q fever fatigue syndrome has been reported to occur in 10-25% of some acute patients, characterized by constant or recurring fatigue, night sweats, severe headaches, photophobia pain in muscles and joints, mood changes, and difficulty sleeping.

### **SLIDE 34**

Chronic Q fever is a severe disease occurring in <5% of acutely infected patients, symptomatic or asymptomatic. Chronic Q may present within months to years to decades after acute infection. *Coxiella burnetii* has the ability to persist for long periods of time in the host after infection. The three groups at highest risk for developing chronic Q fever are pregnant women, immunosuppressed persons and patients with a pre-existing heart valve defects. Endocarditis is the major form of chronic disease, about 60-70% of all reported cases. The estimated case fatality rate in untreated patients with endocarditis is 25-60% and it is fatal without treatment. Chronic Q fever is a difficult diagnosis, only 12% of patients have vegetative lesions on Echocardiography. . Other forms of chronic Q fever include chronic hepatitis, chronic vascular infections, osteomyelitis, osteoarthritis and chronic pulmonary infection.

### **SLIDE 35**

In the US, persons aged 60-64 years have the highest age-related risk of Q fever, the majority of symptomatic cases are males, and more cases are diagnosed in the spring, probably correlating with livestock birthing times or farm management practices.

### **SLIDE 36**

This graph shows the Q fever cases reported in North Carolina from 2008 through SEPT 2013 by symptom onset. Among 23 cases, 20 were classified as Acute (16 probable and 4 confirmed) and 4 cases were reported as confirmed Chronic cases. One patient in 2012 was classified as both a case of confirmed acute and chronic. Among these 23 patients, 16 or (70%) were male, their age ranged from 20 years to 83 years old with a median age of 62 years. The most common activity or risk factor consistently reported by patients within the incubation period

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was proximity to livestock (cattle, goats or sheep) 14 of 23 or (61%) and foreign travel to at risk countries 9 of 23 (39%); some of these risks were not mutually exclusive. Countries of travel or recent immigration included: Iraq (1), Afghanistan (2), Dubai UAE (1), Jordan, (1) Africa, (2), Latin America (1), and Mexico (1). Five cases had unknown sources of exposure and one reported a tick exposure. Three males were deployed in the military, one in Iraq and two in Afghanistan, and one female was a spouse of a military stationed in Dubai United Arab Emirates.

### **SLIDE 37**

This slide displays the 2009 Case Definition criteria for a confirmed case of Acute Q fever, the clinical evidence is in the box on the left and the laboratory confirmed criteria (box on the right). A confirmed acute Q fever case must have laboratory confirmed criteria and either meet clinical case criteria or be epidemiologically linked to a lab confirmed case.

### **SLIDE 38**

A Probable Acute Q fever case must meet clinical evidence criteria for acute Q fever illness and have laboratory supportive results for past or present acute disease (antibody to Phase II antigen) listed on this slide. Serological test results must be interpreted with caution, because baseline antibodies may be present from historical exposures to Q fever, especially for persons that live or have lived in rural or farming areas.

### **SLIDE 39**

A Confirmed case of Chronic Q fever must meet clinical evidence criteria for chronic Q fever and be laboratory confirmed for chronic infection.

### **SLIDE 40**

A Probable case of Chronic Q must meet clinical evidence criteria for chronic Q fever and have laboratory supportive results for past or present chronic infection (antibody to Phase I antigen).

### **SLIDE 41**

One of our primary goals in public health is primary prevention of disease and we do this through education of those at risk. In the United States, Q fever outbreaks have resulted mainly from occupational exposure involving veterinarians, meat processing plant workers, sheep and dairy workers, livestock farmers, and researchers at facilities housing sheep. In NC persons that have traveled to endemic countries, primarily military and their families, are at risk for infection with *Coxiella burnetii*. Prevention and control efforts should be directed primarily toward these groups and environments. Also remember that persons at highest risk for developing chronic Q fever are those with pre-existing cardiac valvular disease, vascular grafts or immune-compromise.

### **SLIDE 42**

As a new CD nurse you will be learning a lot about your community: the people, types of farming operations and species of animals, animal-related industry and occupations, and

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recreational and hunting activities. Now you know how three important zoonotic diseases, (tularemia, brucellosis and Q Fever) are transmitted, the animals and arthropods that are potentially infected, the circumstances and behaviors that result in exposures and the occupations and activities that place a person “at risk” of infection. Having this information provides you with tools to educate your community about these diseases. The following three slides provide additional disease-specific resources and references for each of the diseases discussed today.

**Slide 43**

This slide has Tularemia resources.

**Slide 44**

The resources and references for Brucellosis are on this slide.

**Slide 45**

And Q fever resources and references are on this slide.

**Slide 46**

The Communicable Disease Branch welcomes you and we look forward to working with you! Our contact information is on this slide, please don't hesitate to call the SME or any of us if you have questions or need help with a zoonotic disease investigation.